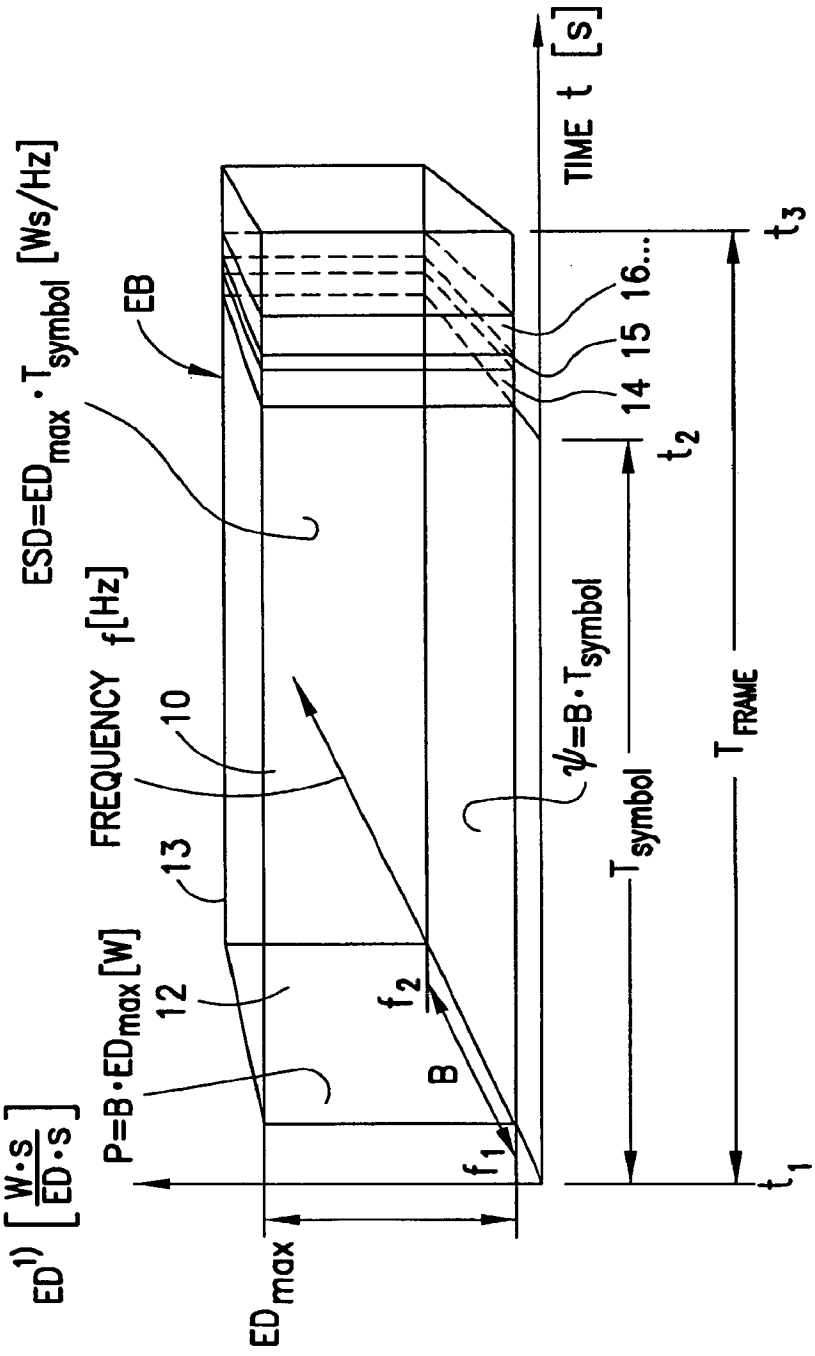
REPLACEMENT SHEET

APPROVED: /W.C./

03/17/2009



[1] ED: ENERGY DENSITY ACCORDING TO WIGNER–VILLE

FIG.1

REPLACEMENT SHEET

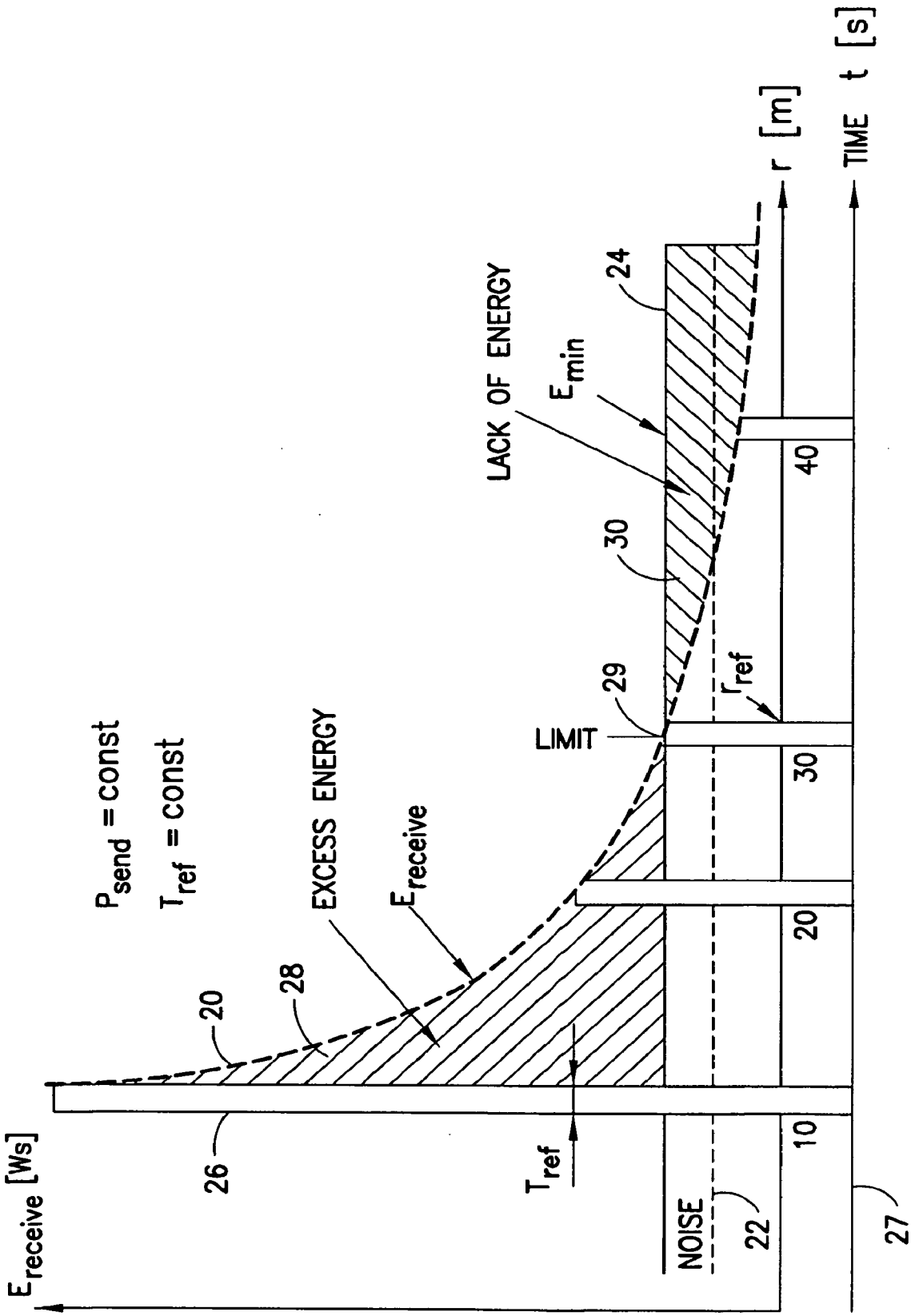


FIG.2

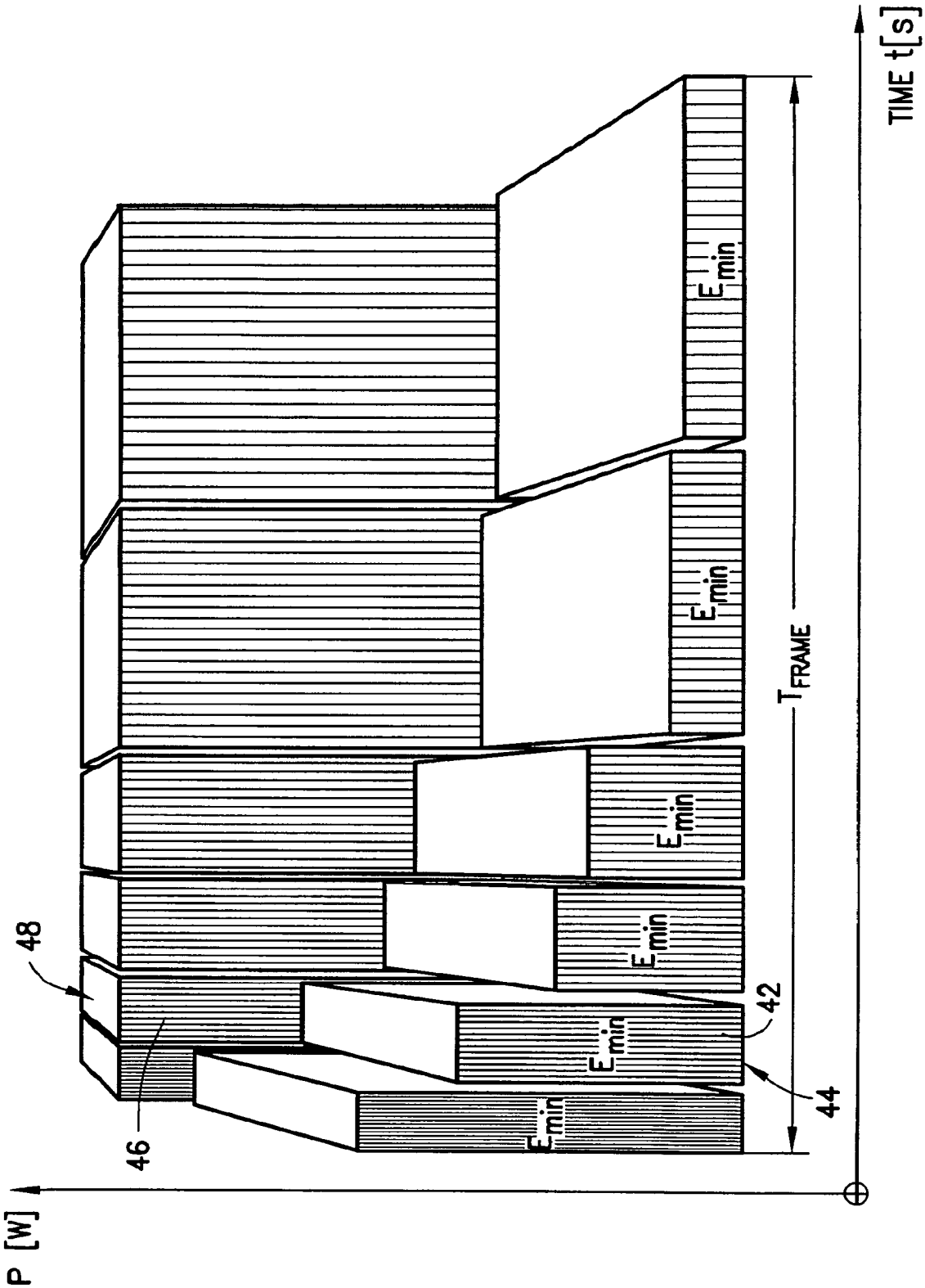


FIG.3

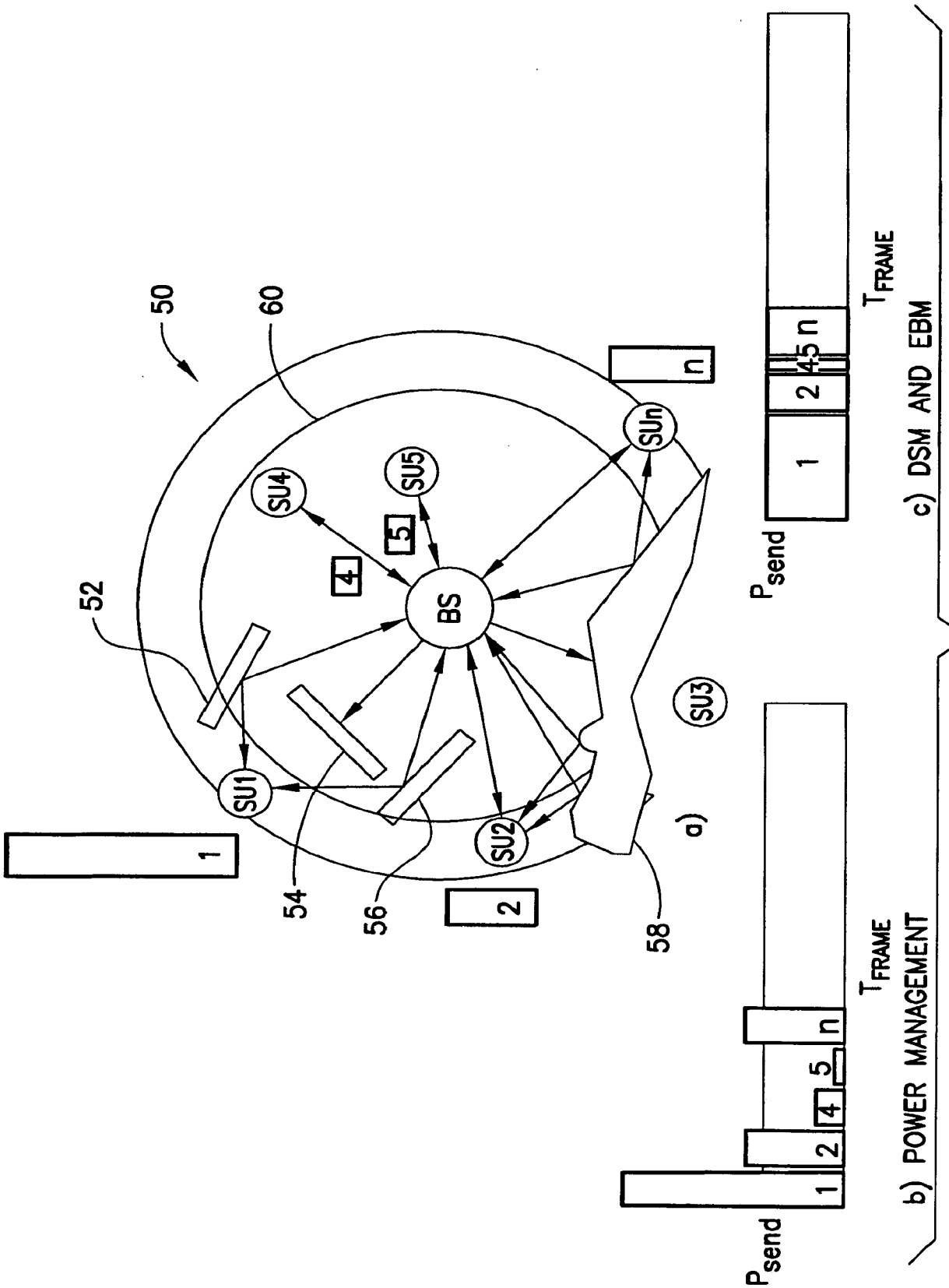

50
60
52
BS
SU1
SU2
SU3
SU4
SU5
SUn
1
2
3
4
5
n
54
56
58
a)
P_{send}
T_{FRAME}
b) POWER MANAGEMENT
c) DSM AND EBM

FIG.4

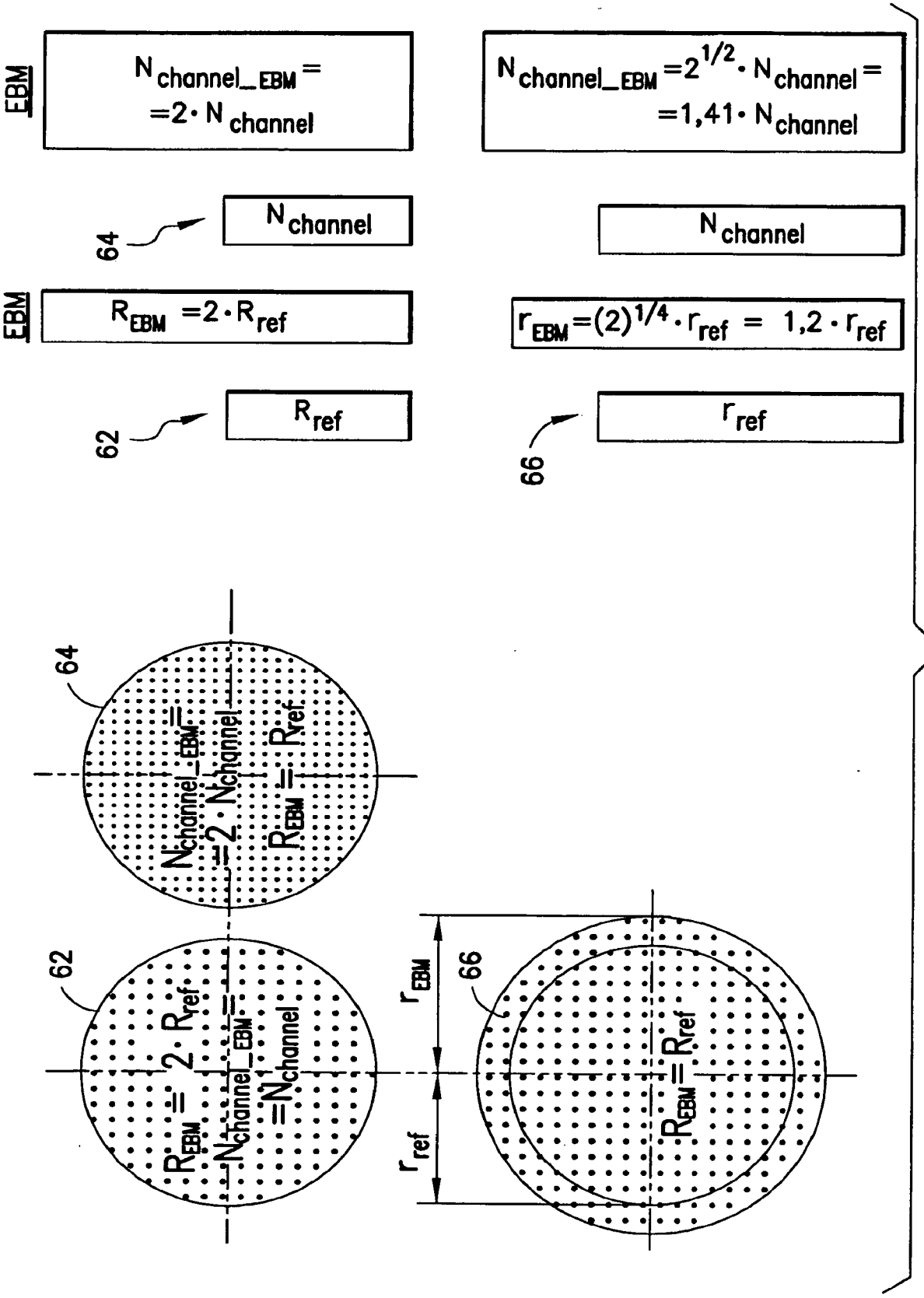

EBM
$N_{channel\_EBM} = 2 \cdot N_{channel}$
$N_{channel\_EBM} = 2^{1/2} \cdot N_{channel} = 1,41 \cdot N_{channel}$
64
$N_{channel}$
$N_{channel}$
EBM
$R_{EBM} = 2 \cdot R_{ref}$
$r_{EBM} = (2)^{1/4} \cdot r_{ref} = 1,2 \cdot r_{ref}$
62
R_{ref}
66
r_{ref}
64
$N_{channel\_EBM} = 2 \cdot N_{channel}$
$R_{EBM} = R_{ref}$
62
$R_{EBM} = 2 \cdot R_{ref}$
$N_{channel\_EBM} = N_{channel}$
r_{EBM}
66
r_{ref}
$R_{EBM} = R_{ref}$

FIG.5

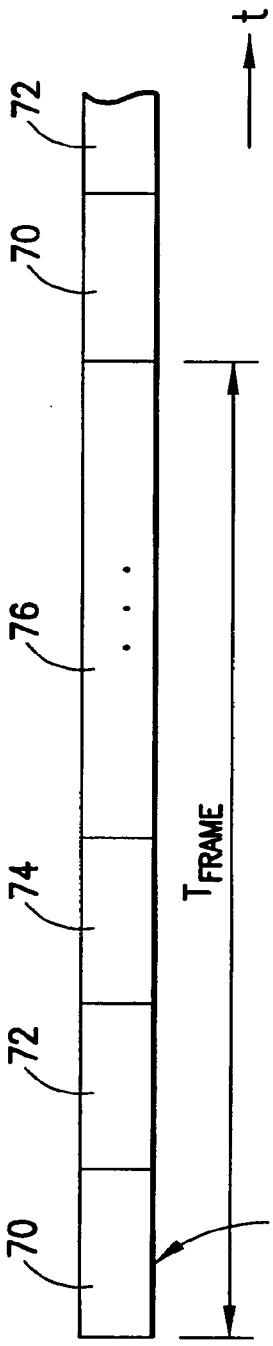

t
72
70
76
74
72
70
T_{FRAME}
Tchannel

FIG.6

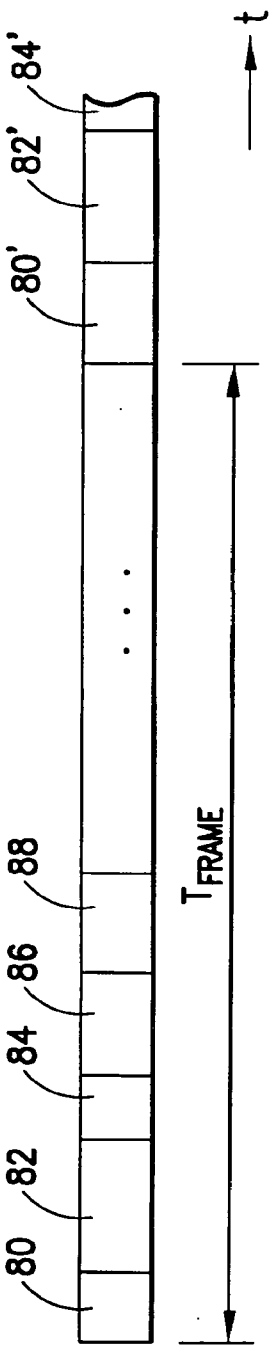

t
84'
82'
80'
88
86
84
82
80
T_{FRAME}

FIG.7

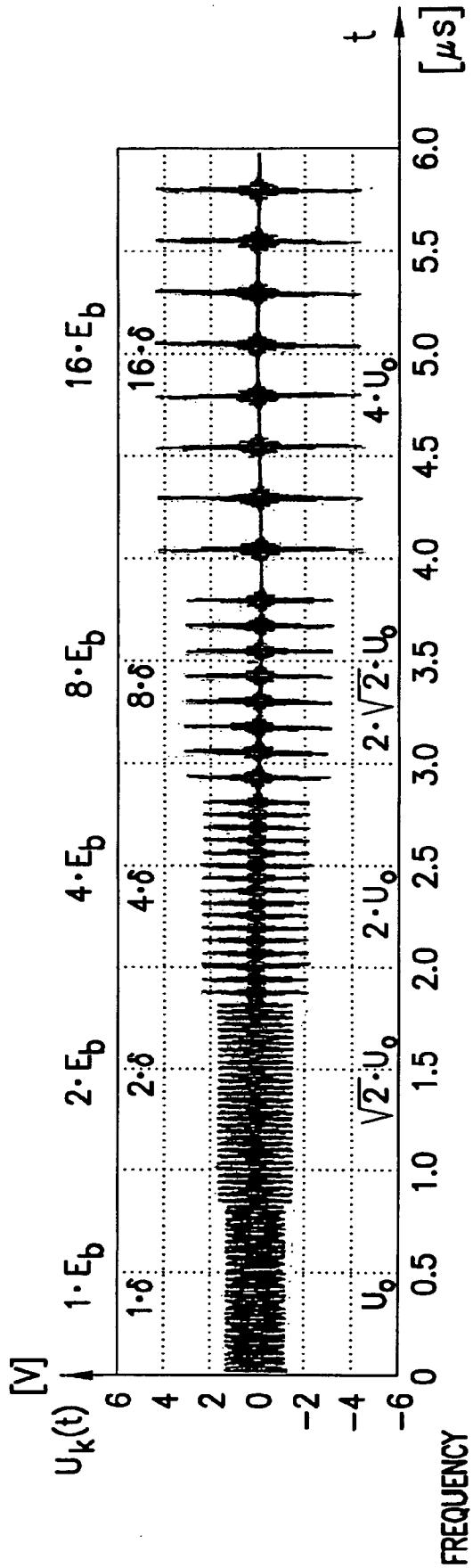

$U_k(t)$ [V]
6
4
2
0
−2
−4
−6
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
t [μs]
1·δ
2·δ
4·δ
8·δ
16·δ
U_o
$\sqrt{2}\cdot U_o$
$2\cdot U_o$
$2\sqrt{2}\cdot U_o$
$4\cdot U_o$
$1\cdot E_b$
$2\cdot E_b$
$4\cdot E_b$
$8\cdot E_b$
$16\cdot E_b$
FREQUENCY SPREADING
$\nu = \frac{B}{R}$

FIG.8a

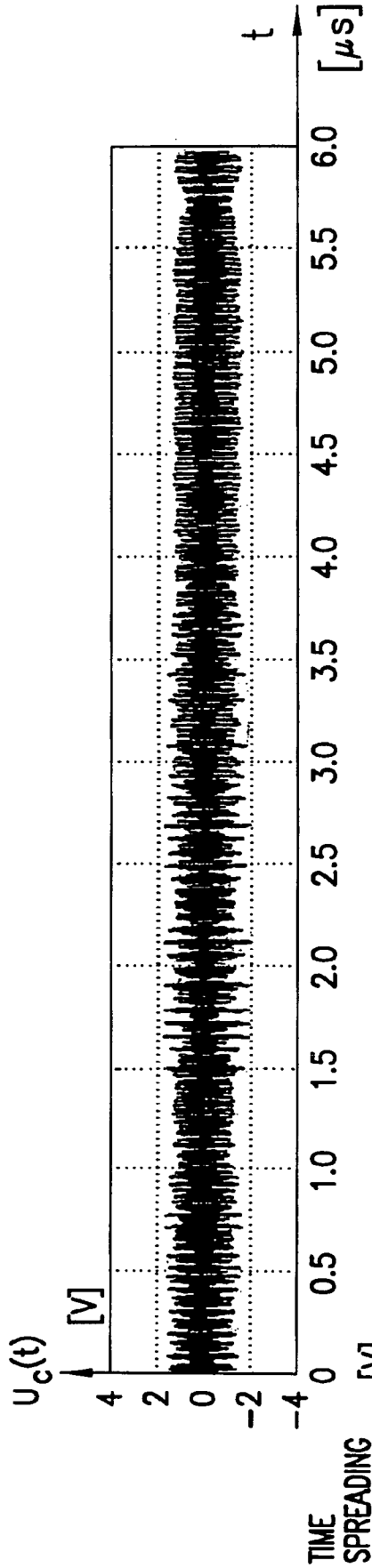

$U_c(t)$ [V]
4
2
0
−2
−4
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
t [μs]
TIME SPREADING
$\psi = \frac{T_{Chirp}}{\delta} = T_{Chirp} \cdot B$

FIG.8b

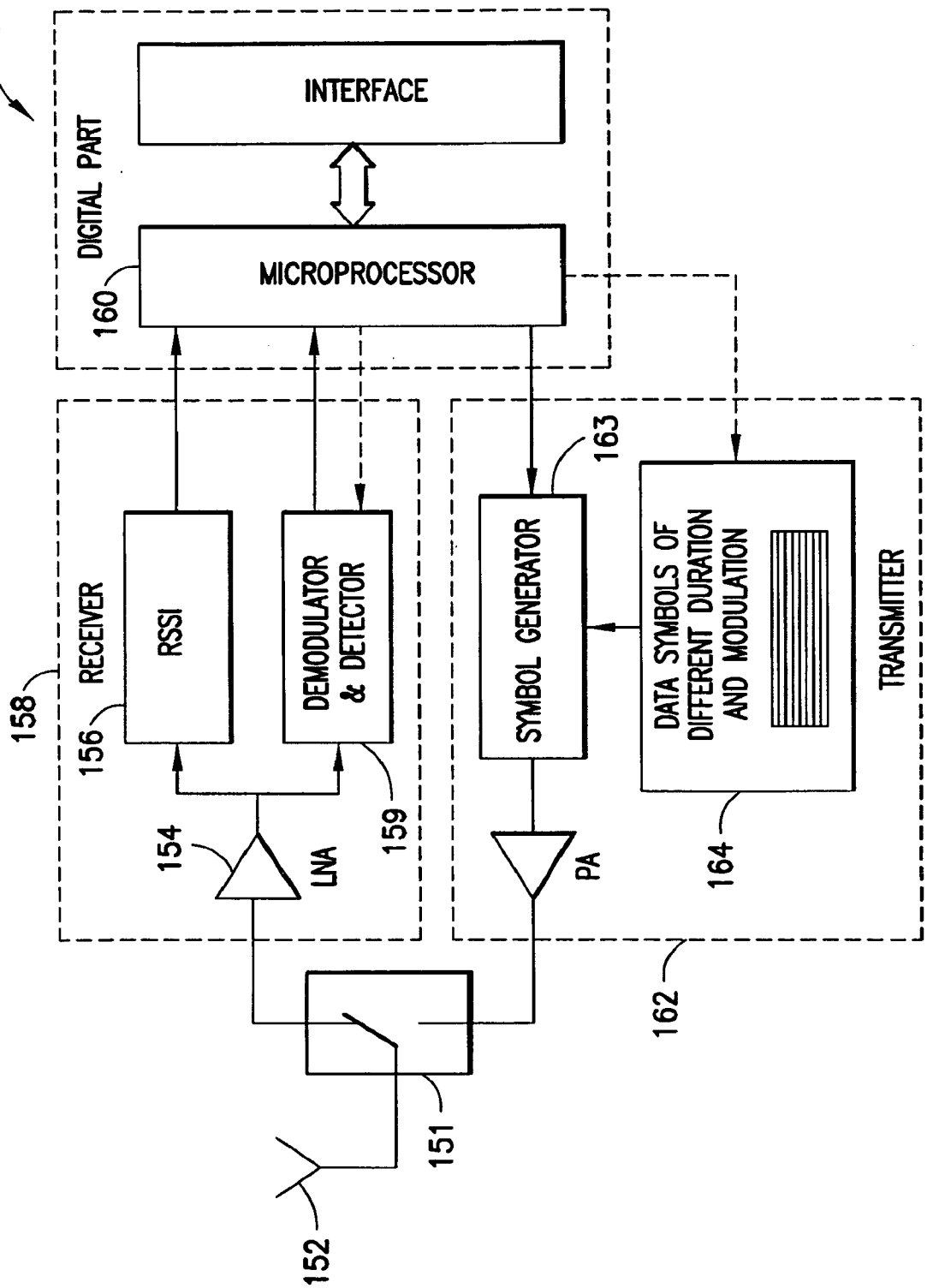

150
DIGITAL PART
INTERFACE
MICROPROCESSOR
160
158
RECEIVER
156
RSSI
DEMODULATOR & DETECTOR
159
154
LNA
163
SYMBOL GENERATOR
DATA SYMBOLS OF DIFFERENT DURATION AND MODULATION
164
PA
TRANSMITTER
162
151
152

FIG.9

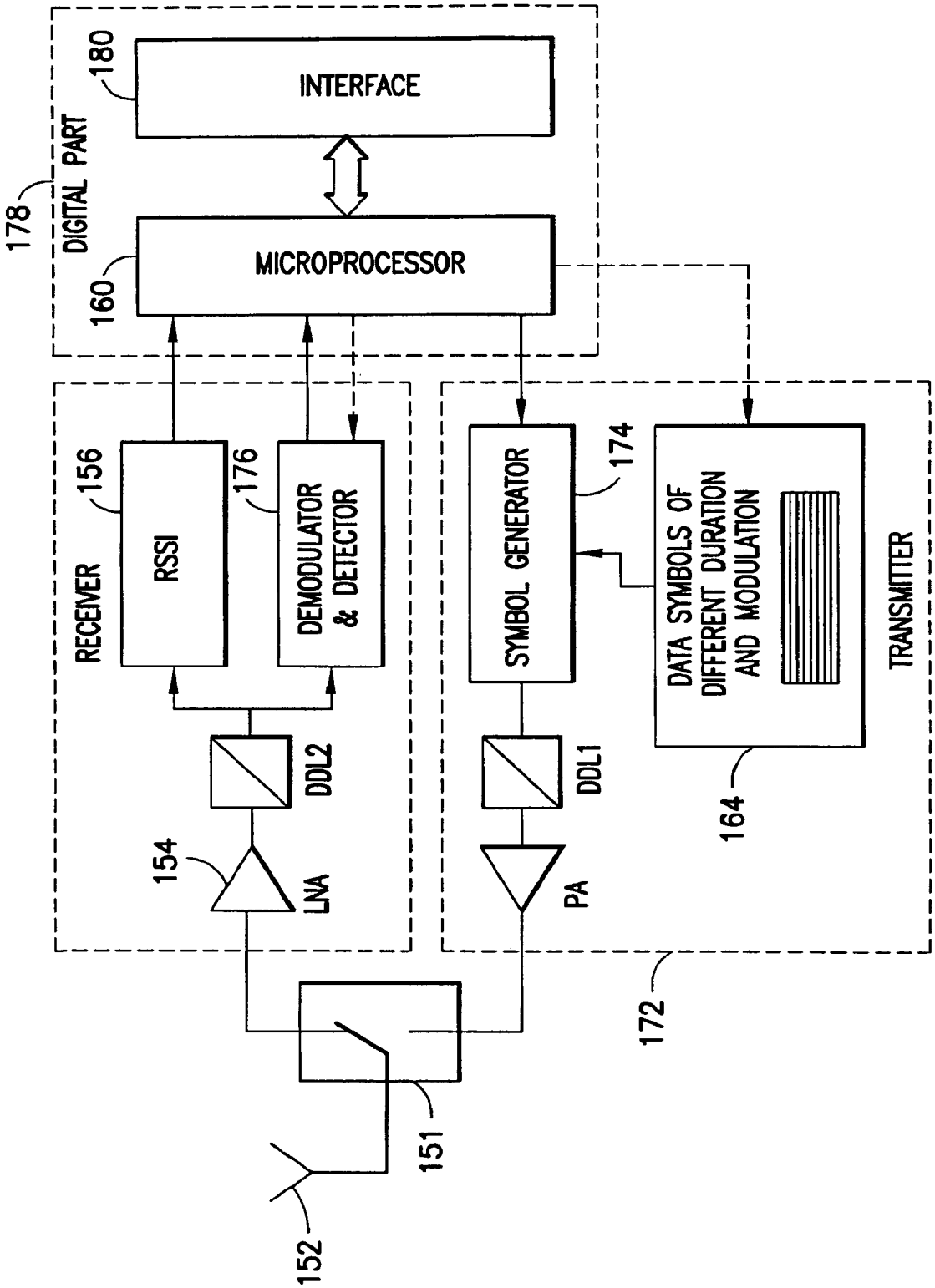

178
DIGITAL PART
180
INTERFACE
160
MICROPROCESSOR
RECEIVER
156
RSSI
176
DEMODULATOR & DETECTOR
154
LNA
DDL2
TRANSMITTER
174
SYMBOL GENERATOR
DDL1
PA
DATA SYMBOLS OF DIFFERENT DURATION AND MODULATION
164
172
151
152

FIG.10

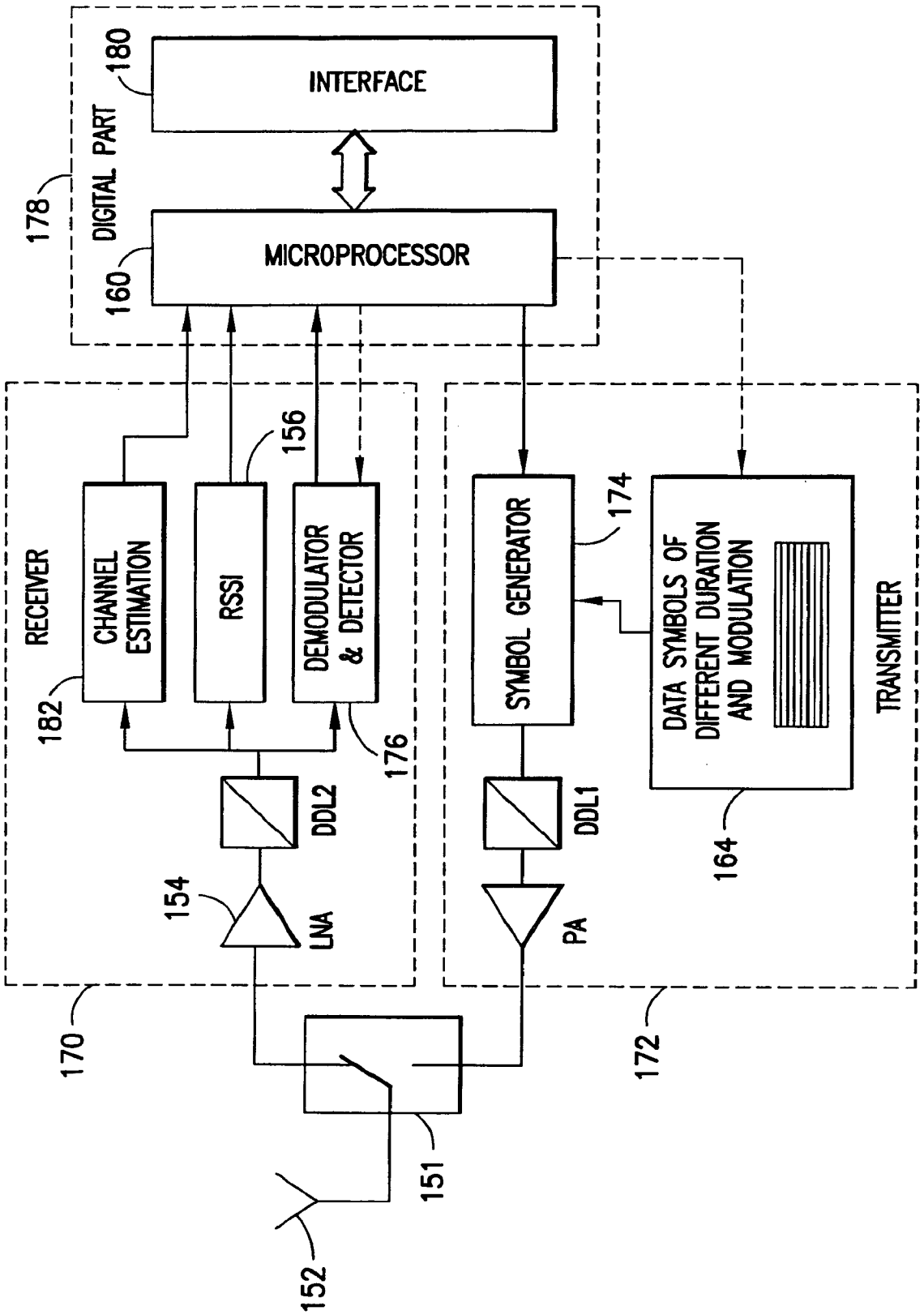

INTERFACE
180
DIGITAL PART
178
MICROPROCESSOR
160
RECEIVER
CHANNEL ESTIMATION
RSSI
DEMODULATOR & DETECTOR
156
182
176
DDL2
154
LNA
170
SYMBOL GENERATOR
174
DDL1
PA
DATA SYMBOLS OF DIFFERENT DURATION AND MODULATION
TRANSMITTER
164
172
151
152

FIG.11

REPLACEMENT SHEET

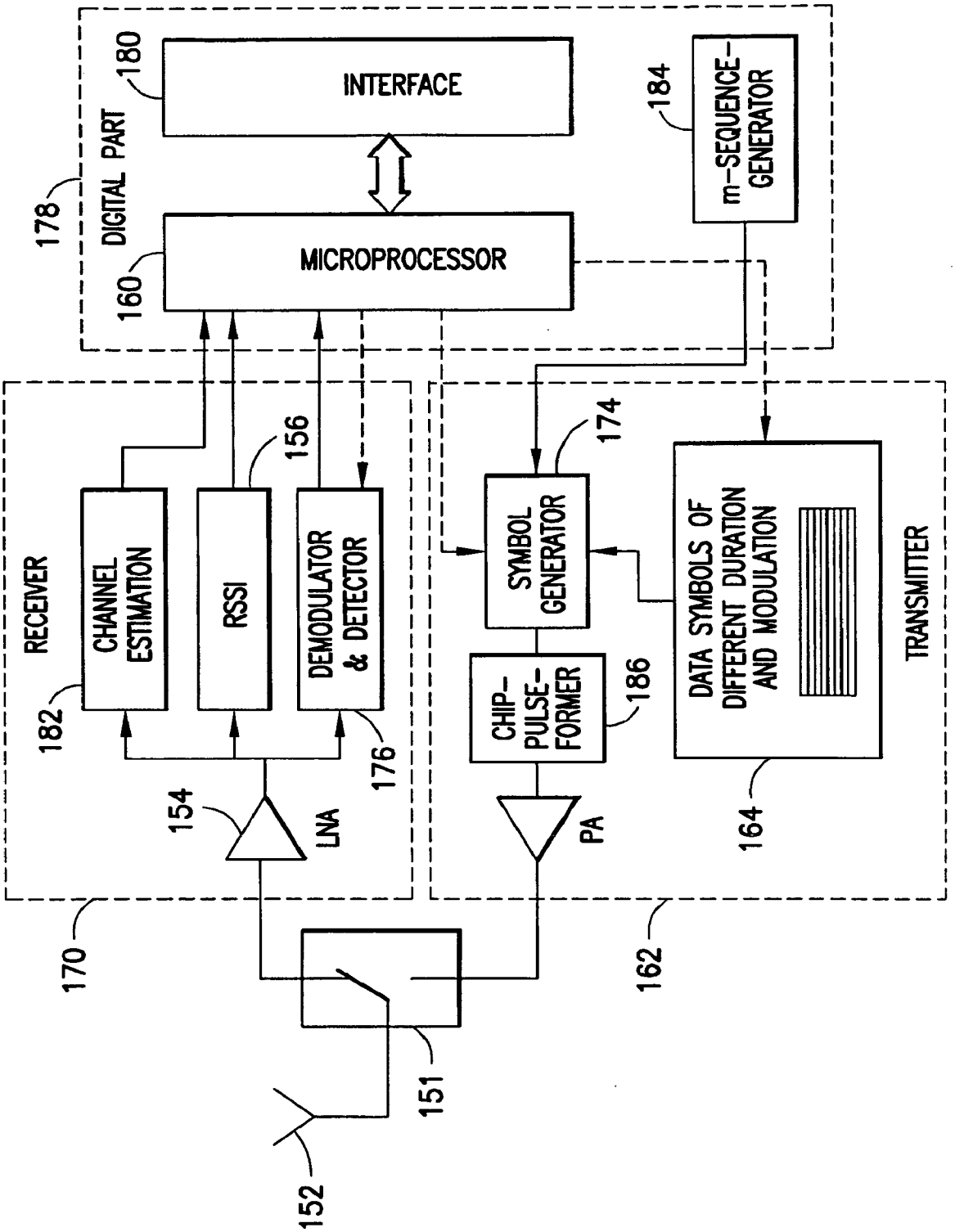
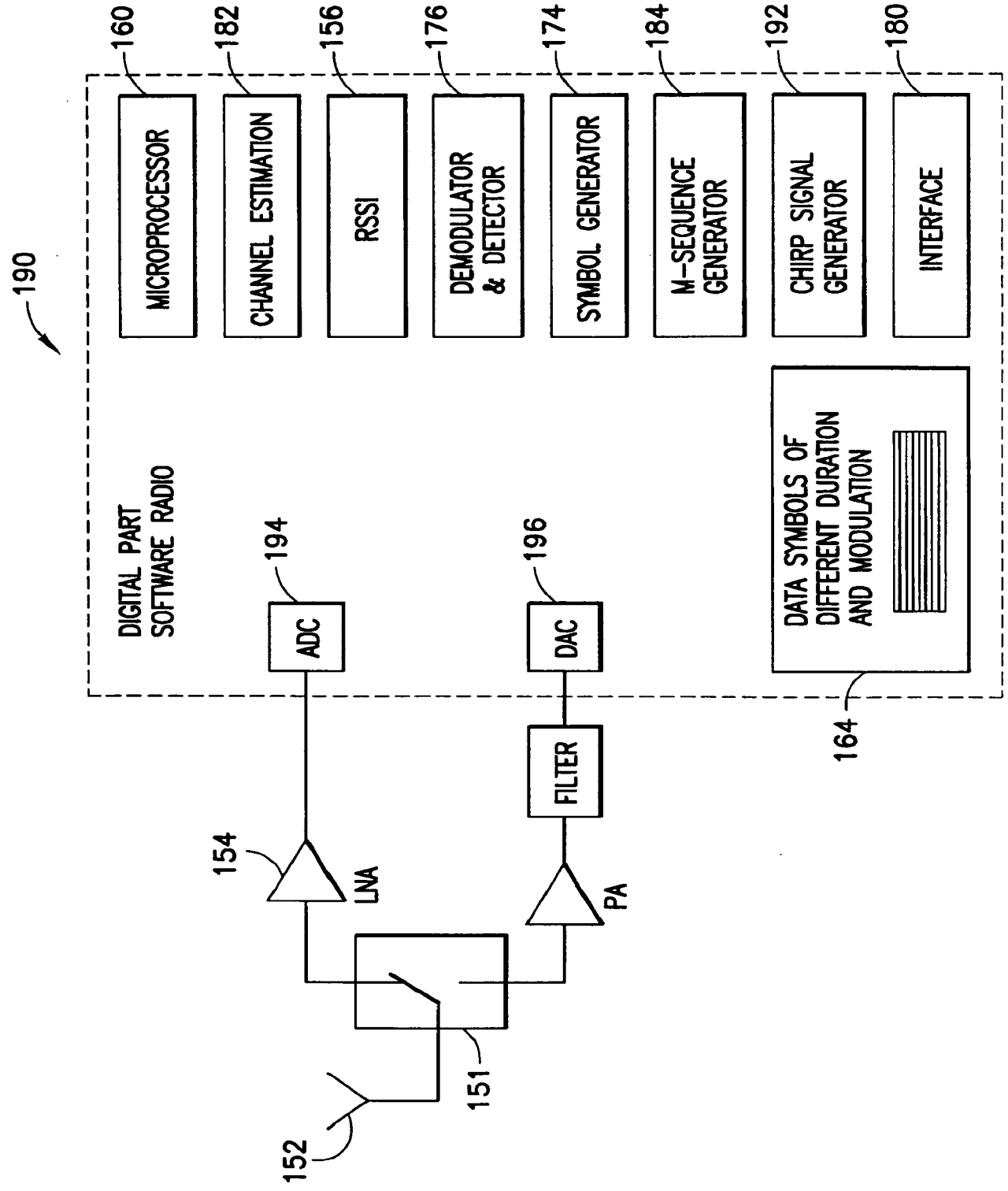


FIG.12

FIG.13


190
160
MICROPROCESSOR
182
CHANNEL ESTIMATION
156
RSSI
176
DEMODULATOR & DETECTOR
174
SYMBOL GENERATOR
184
M-SEQUENCE GENERATOR
192
CHIRP SIGNAL GENERATOR
180
INTERFACE
DIGITAL PART SOFTWARE RADIO
DATA SYMBOLS OF DIFFERENT DURATION AND MODULATION
164
194
ADC
196
DAC
FILTER
154
LNA
PA
151
152

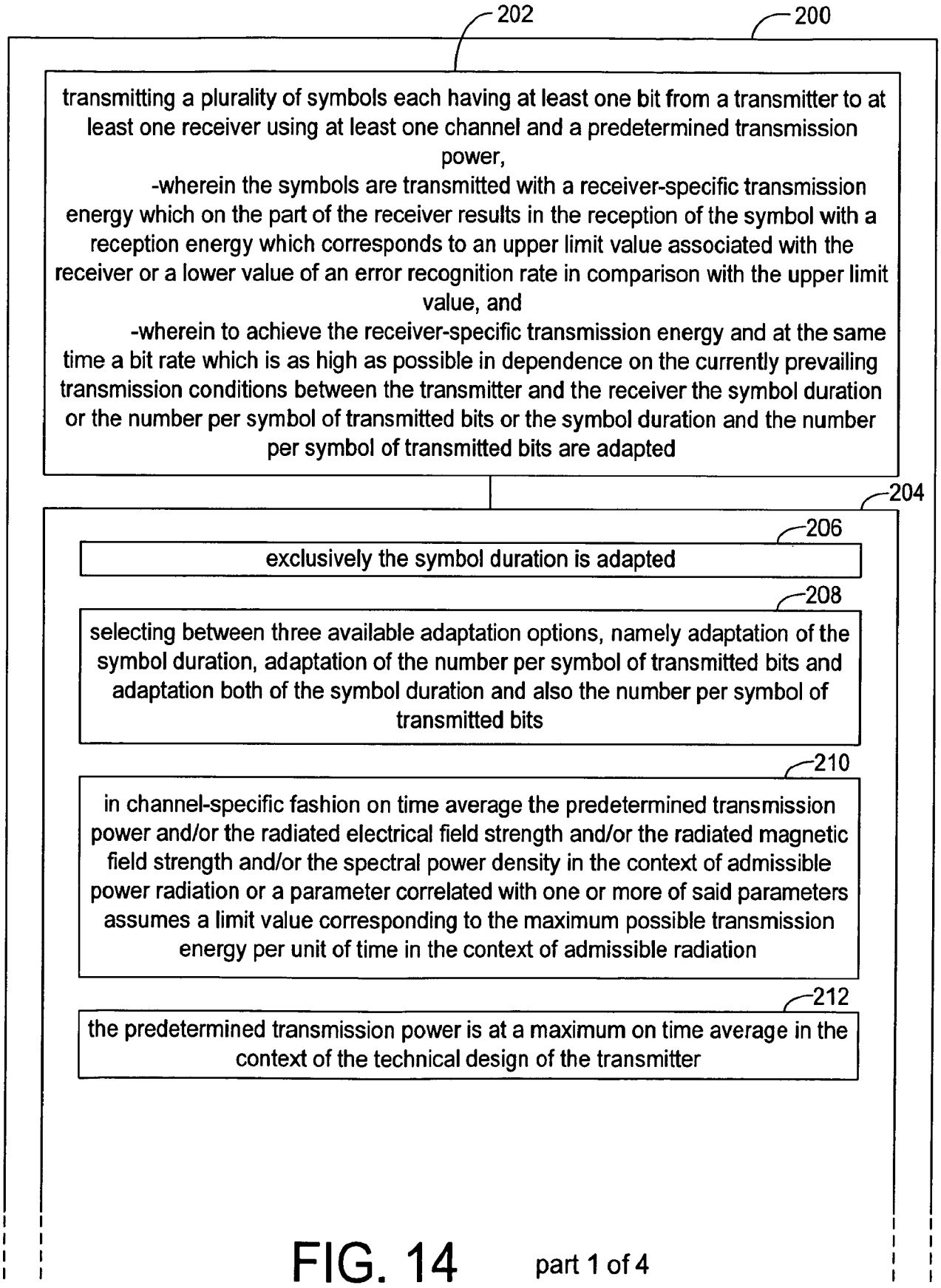


FIG. 14 part 1 of 4

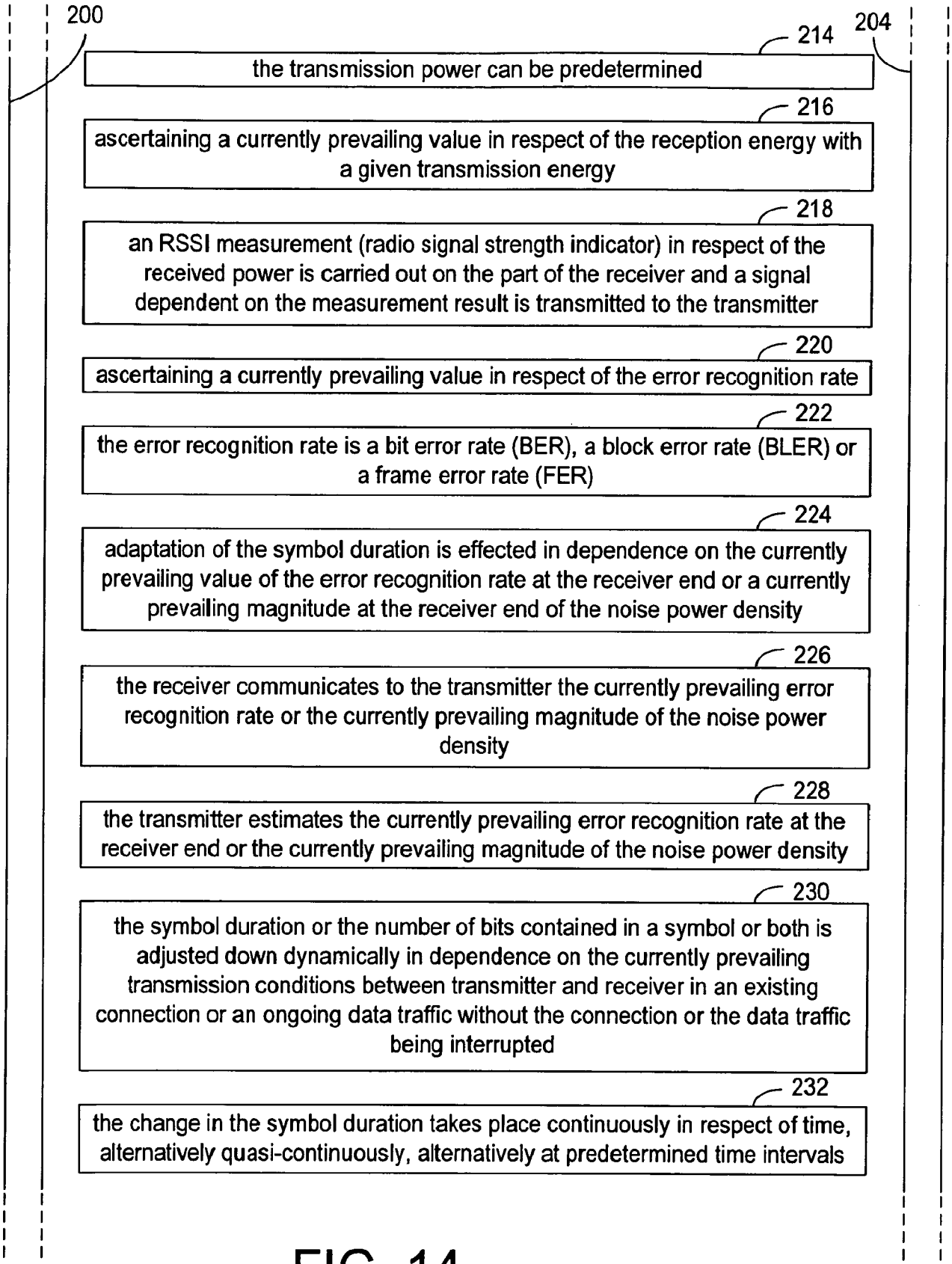


FIG. 14 part 2 of 4

200

204

234 the symbol duration is adapted in channel-specific fashion, that is to say individually on each channel used

236 the symbol duration is restricted towards short symbol duration values in channel-specific fashion by the bandwidth of the channel

238 the symbol duration is determined from a continuous value spectrum

240 the symbol duration is determined from a discrete value spectrum, wherein the discrete value spectrum contains the integral multiples of a symbol duration which is the shortest possible in channel-specific relationship

242 the symbol duration T_{symbol} is determined at the transmitter end in accordance with the formula:

$$T_{symbol} = \frac{E_{\min} \cdot \left(r / r_0 \right)^{\alpha}}{P_{send}}$$

wherein E_{min} is the reception energy corresponding to the upper limit value associated with the receiver in respect of the error recognition rate, P_{send} is the maximum transmission power, r is the distance between transmitter and receiver, r_0 is a reference distance and α is a propagation coefficient

244 the selection of the number per symbol of transmitted bits is effected in dependence on the currently prevailing value of the error recognition rate at the receiver end or on a currently prevailing magnitude at the receiver end at the noise power density

246 the number per symbol of transmitted bits is adapted in channel-specific relationship

248 adaptation of the number per symbol of transmitted bits is effected when a symbol duration which is shortest in channel-specific relationship is already used

FIG. 14 part 3 of 4

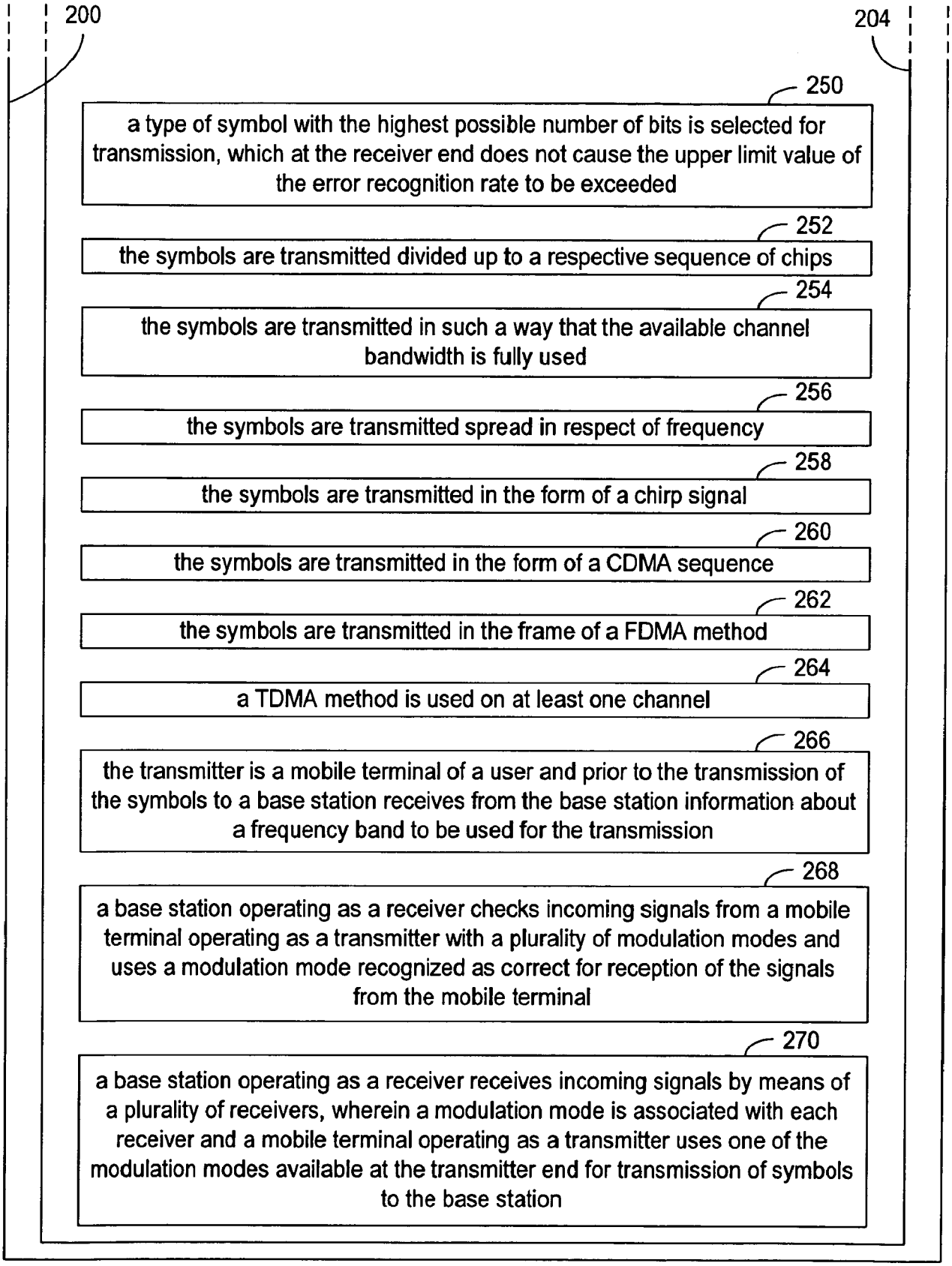


FIG. 14 part 4 of 4

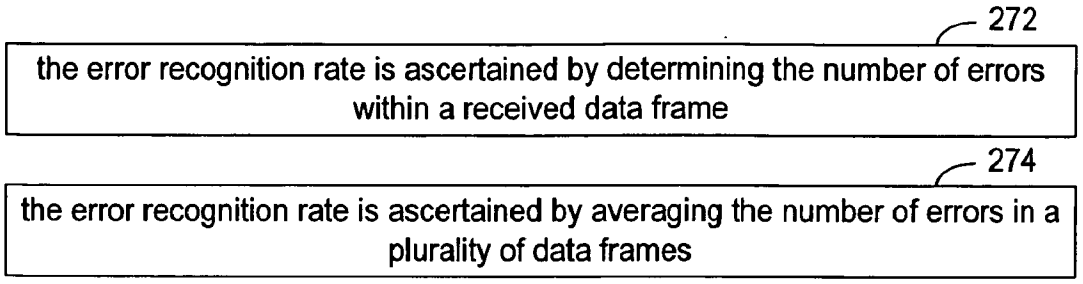


FIG. 14a

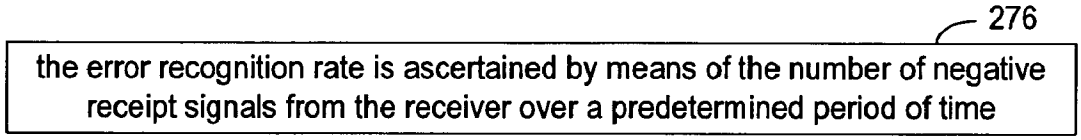


FIG. 14b

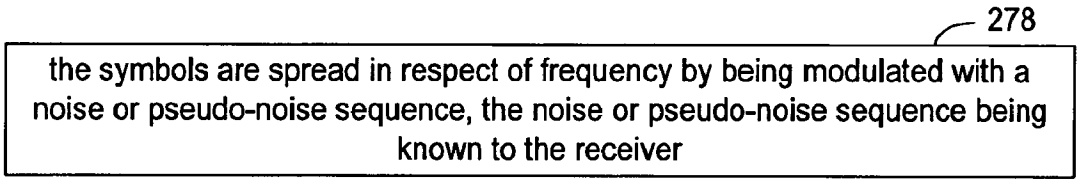


FIG. 14c

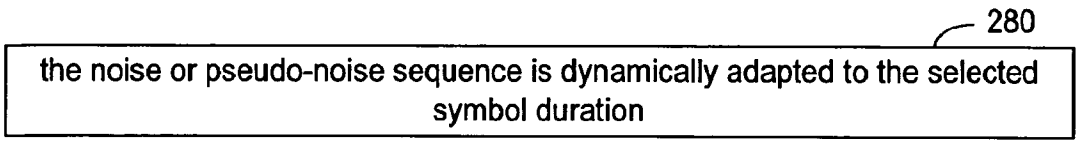


FIG. 14d

282

chirp signals from the transmitter, which are intended for a respective receiver, are superimposed in respect of time

FIG. 14e

284

the total of the transmission powers, radiated in a moment in time, of the mutually superimposed chirp signals is equal to the maximum admissible transmission power on the respective channel

FIG. 14f

286

division into FDMA channels is effected dynamically in such a way that a lower bandwidth is allocated to receivers with good channel transmission conditions

FIG. 14g

300

transmitting a plurality of symbols each with at least one bit from a transmitter to at least one receiver using at least one channel and a predetermined transmission power,
- wherein the symbols are transmitted with a receiver-specific transmission energy which on the part of the receiver leads to the reception of the symbol with a reception energy which corresponds to an upper limit value associated with the receiver or a lower value of an error recognition rate,
- wherein in dependence on the currently prevailing transmission conditions between the transmitter and each individual receiver to achieve the receiver-specific transmission energy and at the same time a bit rate which is as high as possible the symbol duration, or the number per symbol of transmitted bits, or the symbol duration and the number per symbol of transmitted bits are adapted

FIG. 15